Enhanced aerobic capacity with deep water running

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INTRODUCTION

Callisthenics in water have been used for decades in the field of physical medicine and rehabilitation as exercise in this medium aids unloaded, impact free muscle and joint activity.¹ Deep water running (DWR), developed as a means of injury-free training for elite runners, involves running suspended in water deep enough so that the foot does not contact any solid surface at any time. While the principle of ‘specificity of training’ suggests that maintenance/gain in fitness by water training methods may not translate to equivalent gains on land, a number of studies have demonstrated that DWR produces similar results to land training for maintenance of running performance amongst elite athletes.^{2–5} Thus, DWR is the most prominent form of cross-training in elite runners.⁶ However, the benefits of DWR in previously untrained individuals are debated with conflicting results reported by workers.

This study was conducted to assess if DWR concomitant with land training is associated with improvement of aerobic capacity in sports personnel who undergo regular training but are new to this modality.

MATERIALS AND METHOD

Thirty male hockey and cricket players formed the study group for examining the effects of eight-week DWR. At the time of inclusion the subjects had been training on land for > six weeks after a two-month break. All subjects were free of illness and provided the informed consent to carry out the study. Since only 10 sets of aqua-training equipment were available the study group was divided into three sub-groups of 10 each for training. The three sub-groups undertook eight weeks DWR training one after the other over a 24-week period. They continued training on land throughout the duration of the study.

Tests for aerobic and anaerobic capacity were performed in each group the day before and after the DWR training period. Deep water running was performed using aqua-training equipment consisting of floatation belts and aqua-training shoes and anklets (Figure 1).⁷

The athletes trained three alternate days one week for eight weeks. Each session lasted for 65 minutes with five minutes warm-up, 50 minutes interval DWR and 10 minutes of warm-down. Using the Borg rate of perceived exertion (RPE) scale, the subjects were made to run at a severe RPE for three minutes followed by moderate RPE for two minutes alternatively for three cycles of 15 minutes each with a two minute break at the end of each cycle. The subjects continued to train on land as per protocols developed by their coaches through the study period.

Aerobic capacity was tested before and after eight weeks of DWR by a 1.6 Km run and assessment of VO_{2max} (on a Monark 839E bicycle ergometer using the Astrand protocol). Anaerobic capacity was assessed by a 100 m sprint speed plus average mechanical power generated in a 12-second multi-jump test. The ergo timer and ergo tester from Globus, Italy were used for measurements. Similar ambient conditions were ensured for the pre- and post-DWR training tests.

RESULTS

The subject population were in the mean age group of 28.06 ± 3.45 years, weight 66.14 ± 8.41 Kg and height 169.49 ± 4.45 cm. The results of tests before and after DWR training are shown in Table 1.

Figure 1 Aqua-training apparatus: floatation belt (extreme left); anklets and ‘shoes’ (extreme right).

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Table 1 Results of tests of aerobic and anaerobic capacity with deep water running training.

	Test name (units of measurement)	Pre-DWR training	Post-DWR training	Significance of difference of means
Aerobic capacity	1.6 Km run (Km/hr)	15.13±1.11	15.65±0.99	P=0.001
	VO _{2max} (mL/Kg/min)	45.3±7.88	49.7±8	P=0.005
Anaerobic capacity	100 m sprint (Km/hr)	24.85±1.36	24.92±1.77	P=0.72
	Multi-jump (W)	42.08±11.8	40.24±8.78	P=0.31

DWR: deep water running.

Seven subjects suffered lower limb injuries during the training and competition season. Four subjects had muscular trauma of the thigh and calf muscles, two had ankle joint sprains and one had a tibial stress fracture. The last subject had to stop training altogether and was dropped from the study. The other six subjects stopped training on land but continued training in water and their aerobic capacity changed insignificantly after eight weeks of DWR.

DISCUSSION

Deep water running has been shown to produce a differential training effect depending on the pre-DWR training status of the individual. A number of studies have reported maintained aerobic capacity amongst elite runners training with DWR instead of land running for periods of up to eight weeks.^{3–5} The benefits of DWR in sedentary people and those newly introduced to the modality are however debated.

Some authors report maintained pre-DWR VO_{2max} in untrained individuals⁷; however, Michaud et al found a very significant gain in VO_{2max} in both a DWR test as well as a treadmill test in 10 healthy sedentary individuals trained with an eight-week progressive, aerobic, interval DWR programme for three days one week at 63–82% heart rate maximum for 16–36 minutes.⁸ Their protocol caused an improvement in the aerobic capacity with a carryover effect to land running (treadmill) performance. In this study a significant improvement in the aerobic performance on land has been demonstrated with eight weeks of DWR in subjects who were neither elite athletes nor sedentary individuals. They were new to DWR; however, probably because of being sportsmen they could pick-up the technique rapidly and effectively.

The improved aerobic capacity in the subjects of this study after DWR is most likely due to (a) a direct effect of DWR, i.e. the subjects performed a large volume of moderate to high intensity water running leading to a large training effect and (b) an 'additive' effect as they performed concomitant land

and water exercises for the entire duration of the study. This is in accordance with the 'overload principle' whereby achieving an appropriate overload for the purpose of eliciting a training response requires manipulation of training frequency, intensity, and duration with a focus on the exercise mode.² Of particular interest is the finding that even subjects with injuries of the lower limb musculature and joints could continue training in water and did not lose previous training gains because of injuries.

Tests of anaerobic power, however, did not show any significant improvement in our subjects as the training protocol employed in this study did not have a significant power component. The lack of decrement in anaerobic parameters after DWR training probably is a result of the concomitant land training performed by the subjects. Based on our findings we suggest that DWR may be employed as a non-traumatic training modality supplementary to moderate intensity land training to help sportsmen and sedentary individuals improve their endurance capacity. This study reiterates the utility of DWR for injured sportsmen who cannot afford to lose training gains yet are unable to train on land due to injury.

CONFLICTS OF INTEREST

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